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WAR DEPARTMENT TECHNICAL BULLETIN

MEDICAL AND SANITARY DATA ON THE MOLUKKEN ISLANDS AND ISLANDS IN THE EASTERN PART OF THE BANDA SEA

135288

War Department, Washington 25, D. C. • • • 21 July 1944

Section I

PUBLIC HEALTH AND ENVIRONMENTAL FACTORS INFLUENCING HEALTH AND SANITATION

1. PUBLIC HEALTH DEPARTMENT. a. Organization. The Molukken Islands and the islands in the eastern part of the Banda Sea are included, for purposes of public health and medical service, in the residency of Molukken. This residency also includes Dutch New Guinea and a group of islands northeast of Timor (Southwestern Islands). The residency of Molukken consists of the following five districts each of which is subdivided as noted.

(1) *District of Amboina.*

(*a*) Amboina—Administrative Post Amboina.

(*b*) Saparoea—Administrative Post Saparoea.

(*c*) Banda—Administrative Post Banda.

(*d*) Boeroe—Administrative Post Namlea.

(*e*) East Ceram—Administrative Post Geser.

(*f*) West Ceram—Administrative Post Piroe.

(*g*) Wahai (Ceram, N. coast)—Administrative Post Wahai.

(*h*) Amahai (Ceram, S. coast)—Administrative Post Amahai.

(2) *District of Ternate.*

(*a*) Ternate—Administrative Post Ternate.

(*b*) Soela Islands—Administrative Post Sanana.

(*c*) Batjan Islands—Administrative Post Labocha.

(*d*) Djailolo (Halmahera)—Administrative Post Djailolo.

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(*e*) Weda (Halmahera)—Administrative Post Weda.

(*f*) Tobelo (Halmahera)—Administrative Post Tobelo.

(3) *District of Toeal.*

(*a*) Kai Islands—Administrative Post Toeal.

(*b*) Aroe Islands—Administrative Post Dobo.

(*c*) Tanimbar Islands—Administrative Post Saumlakki.

(*d*) Southwestern Islands—Administrative Post Wonreli (on Kisar Island).

(*e*) Upper Digoel—Administrative Post Tanahmerah.

(*f*) South New Guinea—Administrative Post Merauke.

(4) *District of Northern New Guinea.*

(*a*) Manokwari—Administrative Post Manokwari.

(*b*) Sorong—Administrative Post Sorong.

(*c*) Seroei—Administrative Post Seroei (Japen Island).

(*d*) Hollandia—Administrative Post Hollandia.

(*e*) Sarmi—Administrative Post Sarmi.

(5) *District of Western New Guinea.*

(*a*) Fakfak—Administrative Post Fakfak.

(*b*) Inanwattan—Administrative Post Inwattan.

(*c*) Midden Vogelkop (Central Bird's Head)—Administrative Post Aja Maroe.

(*d*) Mimika—Administrative Post not determined in 1938.

b. In general, New Guinea and the Southwestern Islands will not be discussed in this survey; for details of these areas see TB MED 18, 10 March 1944, and TB MED 75 (when published).

c. The chief of the Public Health Service of the Molukken Islands resided in the city of Amboina. He was responsible to the public health inspector at Makassar in Celebes. The latter reported directly to the Chief of the Central Public Health Service in Batavia. In 1938 a physician was stationed at all the administrative posts listed in the previous paragraph. These physicians were responsible both for medical care and for promotion of public health, functions which in this area were inseparable. In most places where a physician was stationed, a mantri (graduate Indonesian male nurse) was also located (table I).

d. Every subdivision had one or more vaccinators (table I). East Ceram had two vaccinators, one for eastern Ceram proper, the other for the adjoining islands. In western Ceram one was stationed at Piroe and one at Riring. There were two in the Tanimbar Islands, one of whom was in Larat, the other in Saumlakki.

e. Every government physician was obliged to make a monthly inspection trip lasting 10 to 14 days. On these trips spleen indexes and parasite indexes were ascertained, mosquitoes were captured, and breeding places were sought. In most areas the conveyance used for these tours of inspection was a proa; occasoonally a larger ship was avaliable. The trip often had to be interrupted because of the weather and in certain seasons inspection trips were impossible. During such trips a mantri directed the hospital of the area.

2. WATER. a. In the north and west part of this area the islands are rough and mountainous. The larger islands are heavily forested. Ceram in the center of the area has large central mountains, and the islands in the southeast part of the area are low islands, some heavily forested. These islands are of volcanic and coral origin. Rainfall is greatest in the large islands in the north and west portions of the area, ranging from 70 to slightly more than 100 inches per year in the coastal regions and possibly reaching 150 inches in the highlands. In the southeast portion of the area, however, rainfall is somewhat less (82 inches on the Aroe Islands and 65 inches on the Tanimbar Islands). The amount of water available varies considerably among the islands. Perennial streams are found on the larger islands in the north, west, and central groups. Smaller islands in this part of the area and all of the islands in the southeast portion usually have few streams, all nonperennial, and seasonal droughts occur in many of these latter islands. Perennial streams, where they occur, afford a dependable and adequate supply of water. On some of the islands, such as Halmahera and Ceram, rivers sometimes disappear into a limestone formation to reappear at a lower elevation as great springs. Springs are numerous in most of the north, west, and central islands. There are many shallow wells on all of the islands in the north, west, and central portion and some wells in the islands of

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the Kai group. These native wells are shallow, open, dug wells, and many are near the coast where the water may be slightly brackish. The porous rock formations underlying these islands are permeated by sea water upon which floats a lens of fresh water. This lens may be quite thin on the small coral islands but may extend to a considerable depth on the larger islands. Thus where brackish water is obtained from wells near the coast, fresh water may be obtainable from wells sunk farther inland. On many of the islands wells could be drilled, which would deliver adequate quantities of good water. Lakes are uncommon generally and probably absent in smaller islands in the southeast portion of this area. In all parts of the area, rain water collected from roofs and stored in cisterns or tanks is an important source of water for drinking and culinary purposes. On Tanimbar, Aroe, and Banda Islands it is practically the only source. On Banda, additional water is obtained by condensing the steam from the volcano craters on Nila, Leolu, and Seroea. Thermal springs, some mineralized, occur on Halmahera, Amboina, Boeroe, and possibly other islands of this area.

b. The only distribution systems of which there is a record are at the town of Ternati on Ternati Island, at the town of Amboina on Amboina Island and the towns of Boela and Riring on Ceram Island. The Amboina supply is the largest of these, but it does not serve the entire community. These supplies are described in section IV, which contains supplemental data on individual islands or groups of islands.

c. On the larger islands, water from limestone springs is hard, but stream and spring water may be quite palatable. Stream water on some islands and water from dug wells in all of the islands are likely to be unpalatable because of the high content of organic matter. Wells on the smaller islands and coastal wells on the larger islands may be brackish, particularly if overpumped. All water on these islands from whatever source must be considered to be contaminated and unsafe for use without treatment.

3. WASTE DISPOSAL. a. Water-borne sewerage systems do not exist. Some of the European houses have cesspools or septic tanks, the construction of which is often faulty. The cleanest of the natives deposit their excreta on the beach or on a reef for removal by the ocean. But the children, and often the adults, too, pollute the soil around the houses and trust that animal life will take care of disposal. This results in highly undesirable and offensive conditions until tropical showers clean the village and its surroundings.

b. It has been impossible to teach the natives to use latrines. They are usually willing to build a latrine if convinced or forced by the authorities, but will use it only as long as careful supervision is continued. As soon as supervision is relaxed, the latrine is forgotten.

c. The general sanitary conditions in the cities and the villages are unsatisfactory. Even in Amboina, which is by far the largest of this area, a large garbage dump in the outskirts of the city caused bad odors and was one of the reasons why flies and rats were exceedingly abundant in this city about 1938.

4. INSECTS AND ANIMALS OF IMPORTANCE TO MAN. a. Vectors of Disease. (1) *Mosquitoes.* (*a*) *General.* At least 20 anophelines have been reported from the Molukken Islands (table II) and islands in the eastern part of the Banda Sea. Potential malaria carriers are *Anopheles punctulatus moluccensis, A. punctulatus punctulatus, A. subpictus, A. barbumbrosus, A. kochi, A. vagus, A. umbrosus,* and *A. sundaicus.* In Ceram *A. ludlowii* has been found. *Anopheles bancroftii* is found only in New Guinea.

Of the culicines, *Culex quinquefasciatus* and *Aedes aegypti* are frequent in most of the Molukken Islands. At least 11 different kinds of Culex, 13 species of Aedes and a few species of Mansonia and Armigeres have been reported (table III).

(*b*) *Special data on malaria vectors.* The malaria vectors of these islands are predominantly Australian species.

Anopheles punctulatus punctulatus. The larvae are found in all possible collections of stagnant water, such as waterfilled footprints, gutters, water tanks, tins, ditches, and boats, in clear as well as in turbid water. This species does not breed in flowing water or along the banks of large streams. Since it prefers artificial collections of water, it is dependent on abundant rains for its development. It is, therefore, most often found in settlements recently cleared of

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forests but not carefully drained. It is a nocturnal flier, biting most frequently around 9 PM. Its flight range is approximately three-quarters of a mile. As it attacks silently and produces no pain, its bite is usually unnoticed. *A. punctulatus punctulatus* has been described from all of the Molukken Islands.

Anopheles punctulatus moluccensis. This mosquito lays its eggs in a wide variety of waters—clear or turbid, stagnant or flowing, sweet or brackish. It is found breeding in rapid brooks as well as in gutters and puddles. Like *A. punctulatus punctulatus* it requires exposure to direct sunlight and is never found in deep forests, although it is present in moderate numbers in open forests. Clearing of forests without careful drainage has established endemic malaria in regions where *A. punctulatus punctulatus* and *A. punctulatus moluccensis* occur. *A. punctulatus moluccensis* invades houses during the night and feeds almost exclusively on human blood. It is found in most of the Molukken Islands and eastern islands of the Banda Sea. Wherever it occurs it is probably a very important vector of malaria.

Anopheles subpictus. In general, *A. subpictus* is a coastal brackish water species, although it may also breed in fresh water in the interior at considerable distances from the ocean. Larvae have been found in water with a saline concentration as high as 8.4 percent. It is less dependent upon floating surface vegetation than is *A. sundaicus.* In general, *A. subpictus* is a less active vector of malaria in the Netherlands East Indies than *A. sundaicus* or *A. punctulatus moluccensis. A. subpictus* has been reported from almost all the Molukken Islands.

Anopheles kochi. This was always considered to be a typical house mosquito, but recently has been found to occur in great numbers on the banks of streams. It shows a marked tendency to adapt itself to various types of water, breeding in turbid ponds, on the grassy banks of mountain brooks, in rice fields, and in fresh water fishponds. It feeds more on animal than on human blood, but in areas where cattle are scarce, one-fifth of captured mosquitoes contain human blood. Only in areas where it occurs in large numbers has it been found to be a vector of some importance. *A. kochi* has been observed in many of the Molukken Islands and possibly on Aroe.

Anopheles sundaicus. This species breeds in brackish water along the coast, especially in fishponds and lagoons not freely connected with the ocean. Larvae are seldom found in water without vegetation such as hair grass and seaweed. The mosquito is not found in deep shadowy forests. *A. sundaicus* can fly from 1 to 2 miles, exceptionally even 4 miles. It shows constant differences from the typical *A. ludlowii* of the Philippines which in the Netherlands East Indies is, as far as known, limited to Ceram. In some areas *A. sundaicus* breeds in brackish water with a saline concentration of 0.5 to 1.5 percent. In other areas, however, it is a typical fresh water breeder. In the Molukken Islands *A. sundaicus* has been described only from the Batjan Islands.

Anopheles umbrosus. This species breeds along the coast as well as in the interior, in fresh or brackish water, in puddles and marshes and usually in the shade, but has occasionally been found breeding in open sunlight. In the Molukken Islands it has been reported only from Boeroe.

Anopheles maculatus. The breeding of this species, the vector of coastal hill malaria, occurs exclusively in the hills and mountains, especially in running mountain brooks and wells in sunny places. Macroscopic aquatic vegetation can be wholly lacking and appears to play no role in the life of the larvae. This mosquito is a nocturnal flier, usually biting between 9 p.m. and 2 a.m. Thereafter it leaves the houses and during the day is found mainly on the banks of small streams. The only place in this area from which *A. maculatus* has been reported is the Aroe Archipelago; the accuracy of even this report is not quite certain.

(*c*) *Special data on vectors of Wuchereria bancrofti.*

Anopheles punctulatus punctulatus and *A. punctulatus moluccensis* are important vectors of *Wuchereria bancrofti* in this region. See paragraph 4a (1) (*b*) on malaria vectors for description of their breeding habits.

Culex quinquefasciatus (fatigans). This species breeds near dwellings. The larvae have been found in all sorts of artificial accumulations of water, such as tanks, wells, pits, water barrels, toilets, fountains, cisterns, ponds, springs, canals, and ditches. Stagnant water

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is preferred. The larvae can withstand a salt concentration of 1–1000. This species does not occur in jungles and uninhabited areas. It is found in many of the Molukken Islands. In Ceram, however, it has been observed only near the harbors and is evidently of recent importation. *Culex quinquefasciatus*, which in most places of the world is the most active vector of *Wuchereria bancrofti*, is not an important carrier in any part of the Netherlands East Indies. It is least efficient in the eastern part of the archipelago. In New Guinea it has even been impossible to infect *C. quinquefasciatus* artificially. In the Molukken Islands it has been found naturally infected but only to a very slight degree.

Culex vishnui. This mosquito breeds in various types of places, such as lakes, backwaters, small streams, drainage ditches, flooded grasslands, and irrigation water on rice fields or lagoons. It breeds infrequently in brackish water. The adults are anthrophilic and begin biting as soon as the sun sets. In the Molukken Islands *C. vishnui* has been reported in Amboina only.

Experimental infections of *Anopheles sundaicus, A. subpictus, A. barbirostris, A. vagus,* and *A. tessellatus* have been reported, but there are no records of natural infection. The same holds true for *A. barbirostris* and A. *maculatus.*

Experimental infection and complete development of larvae of *Wuchereria bancrofti* have been obtained in *Culex tritaeniorhynchus, C. fuscocephalus, C. whitmorei, C. annulirostris, C. tritaeniorhynchus,* and *C. sitiens.* None of these species has been found naturally infected.

Aedes scutellaris is a vector of *Wuchereria bancrofti* in the Fiji Islands. This mosquito has a wide distribution in the Molukken Islands and breeds in all sorts of places, including brackish water, crab holes, puddles in coral reefs and depressions in old lava flows.

Aedes vigilax, which has been reported as a possible vector in Australia, has been found in the Aroe and Tanimbar Islands. It breeds in fresh, brackish, or even undiluted seawater. With favorable wind, the adults can be carried 10 to 20 miles, in rare instances, 40 to 50 miles. Although very anthropophilic in Australia, it seems not to be so in the Netherlands East Indies.

None of the Mansonia mosquitoes are known to be vectors of *Wuchereria bancrofti* in the Netherlands East Indies.

(2) *Lice.*—It is generally reported that lice are numerous in the Molukken Islands. These are presumably *Pediculus capitis* as, because of the scantiness of clothing, *Pediculus corporis* and *Phthirus pubis* are probably rare.

(3) *Flies.* (*a*) Careful investigations on Boeroe have revealed the presence of *Musca nebulo, M. sorbens, M. ventrosa, M. vicina, M. vetustissima, Graphomyia maculata, Pyrillia diffidens,* and *Morellia sp.* Of the Calliphorinae, *Chrysomyia megacephala* was found, and of the biting midges, *Culicoides pungens.*

(*b*) No special surveys of the species of Simulium of the Molukken Islands are available, but up to 1935, 18 different species had been reported from Java and Sumatra. Of the tabanids, *Tabanus extricans* and *T. insurgens* have been found in the Batjan Islands; *T. ceramensis, T. cohaerens,* and *T. obscuratus* in Ceram; *T obscuratus* in Amboina; *T. brunneothorax; T. ceylonicus, T. flavipennis, T. reducens,* and *T. succurvus* in Boeroe; *T. aroeensis, T. caesius, T. recusans, T. rufinotatus,* and *T. wollastoni* in the Aroe Islands. *Chrysops signifer* has been reported from the Batjan Islands and from Boeroe; *C. atrivittata* from Boeroe, and *Pangonia amboinensis* from Amboina.

(4) *Ticks and mites.* Three ticks attacking man have been reported from this area: *Boophilus annulatus* from Halmahera, the Soela Islands, Ceram, Amboina, Saparoea, and the Tanimbar group; *Rhipicephalus sanguineus* from Amboina and Saparoea; *Ixodes holocyclus* from the Kai Islands. The itch mite, *Sarcoptes scabiei,* is one of the most frequent human parasites in the Molukken Islands. At least a score of other mites have been reported. One should assume that mites capable of spreading mite-borne (scrub) typhus, and perhaps already infected, will be found throughout this area, even though specific data are lacking at present. In the jungle, chiggers may be a real pest.

(5) *Fleas. Pulex irritans* is rare in the East Indian Archipelago. It has not been found in Sumatra and Celebes but occurs in New Guinea. It may therefore be present in some of the Molukken Islands but has not been so reported.

(6) *Rodents.* Rats are very common in the Molukken Islands. They belong in general to

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the *Rattus rattus* and *R. concolor* group. In Ceram *R. ringens* has been encountered. In Halmahera and the Batjan Islands *R. hoffmanni* has been found. From the Kai Islands *Uromys siebersi*, and from the Aroe Islands *U. aruensis* have been described.

b. Snakes and other dangerous animals. (1) *Snakes.* A poisonous snake, *Acanthopis antarcticus* (the death adder), occurs in most of the southern Molukken Islands but not in Amboina. In addition, *Pseudelaps mulleri* is found in Ceram. In Amboina and other Molukken Islands, five snakes occur. These are *Cerberus rynchops*, *Fordonia leucobalia*, *Dipsadomophus drapiezii*, *D. irregularis*, and *Chrysopelea rhodopleuron*. These species are probably not dangerous. Six poisonous sea snakes live in the seas near the Molukken Islands: *Platurus solubrinus*, *P. schistrohynchus*, *P. laticaudatus*, *Hydrus platurus*, *Hydrophis nigrocinctus*, and *Aipsurus laevis*.

(2) *Crocodiles* are frequent in all parts of the area.

(3) *Other dangerous animals* are rare in the Molukken Islands. Two types of viverrids (wildcats) have been described.

(4) *Poisonous fish.* Poisoning due to the eating of Tetraodontidae (puffer fish) occurs occasionally. The largest concentration of the poison of these fishes is present in the ovaries and testes; it is not destroyed by cooking. Injuries from fishes with spines attached to poison glands, especially *Syncheia verrucosa* (the warty lump fish), may give rise to dangerous inflammation of hands or feet.

(5) Several instances of poisoning due to the eating of turtle meat have been published.

(6) *Poisonous scorpions.* The sting of the scorpions of the Molukken Islands causes local signs, which soon disappear. In Amboina *Isometrus maculatus*, *Lychas mucronatus*, and *Hormurus australasiae* occur. In the other islands, *Hormurus weberi*, *H. caudicula*, and *H. karschi* are also found.

5. FOOD AND DAIRY PRODUCTS IN RELATION TO HEALTH. a. In the Molukken Islands the staple food is sago, which is low in proteins, low in fat, and practically devoid of vitamins. For many years it had been assumed that the native population, if left to its own devices, would escape the dangers of severe nutritional deficiency by supplementing its sago diet with animals caught in the woods and with fish. Nowadays, there is good reason to consider this statement overoptimistic. In addition, it is certain that contact with western civilization usually has had a bad influence upon the general nutrition in this area, because the natives may be induced to abandon their customary diet, which includes caterpillars, maggots, and other animal food rich in proteins and vitamins.

b. An alcoholic beverage obtained from the flowering tops of the palm, *Arenga saccharifer*, is consumed in great quantities throughout the Molukken Islands. The juice from these flowering tops, the so-called "palm wine," is fermented after addition of bitter roots. From this fermentation the popular "sagoweer" or "sageroe" results. Sirih chewing is general among the older part of the population. Opium addiction is rare.

6. MISCELLANEOUS PROBLEMS OF SANITATION. a. Most of the inhabitants of the Molukken Islands have had only superficial contacts with western civilization. Twenty years ago most of the islands had no European physician. Only in the Amboina Archipelago was contact with western culture much older. In recent years the people have shown more confidence in modern medicine. The tribes have been deeply impressed by the effectiveness of neoarsphenamine and always request an intravenous injection, irrespective of the disease from which they may be suffering.

b. The death rate in the island of Amboina, which is one of the healthiest parts of the Molukken Islands, was given as 26.7 per 1,000 in 1923 and 21 per 1,000 in 1931. In the city of Amboina the death rate in 1938 was only 14 per 1,000. Infant mortality was high all over this area, mainly because of malaria and dysentery. In 1923 it was estimated that 16 percent of newborn infants in Amboina died within 1 year. In Ceram the rate was 30 percent.

c. The houses in the Molukken Islands are usually built on poles 3 to 4 feet high. There are a few exceptions. In Amboina only Boetonese immigrants have pole dwellings, while the genuine Ambonese house is built directly on the ground. In the other Molukken islands most of the people live in pole dwellings, ex-

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cept the Christian natives, who throughout the Molukken Islands live in houses of the Ambonese type. Pole dwellings built in the sea at some distance from the coast are found only in a few villages of Soela Sanana inhabited by the Badjorese, a seafaring tribe.

d. Houses are usually constructed of wood, bamboo, sago palm, and gaba gaba (the head nerves of the leaves of the lontar, *Borassus flabelliformis*). The houses are covered with atap, a material which is woven from the leaves of one of these two palms.

Section II

MEDICAL FACILITIES

7. HOSPITALS. a. There were 21 hospitals with 646 beds in the Molukken Islands and eastern Banda Sea Islands. Most of the hospitals were small and poorly equipped (table IV). In Amboina the large military hospital also served the civilian population. In addition, there were seven leprosaria, the largest and best equipped of which was in Amboina (table V).

b. The care of mental disease was completely neglected. In the military hospital in Amboina, five cells existed where psychopathic patients could be isolated, at least if they did not become too noisy. The rest of the mental disease patients of this whole area were kept in prison until they could be transported to one of the special hospitals for mental diseases in Java. The average stay of such patients in prisons was 4 months, but occasionally they had to remain for a whole year before transportation could be obtained.

8. SUPPLIES. The drug supply problem in these remote posts was a complicated one. Most of these little villages were visited only once a month by a steamer. Often drugs had to be rushed by plane from Amboina or even from Batavia to remote outposts when epidemics broke out.

9. MEDICAL PERSONNEL. a. Medical care was furnished by government public health physicians, assisted by native mantris and vaccinators. Table I shows the reported location of such personnel in 1938.

b. In Amboina the military physician acted at the same time as physician of the Public Health Service. His task was so extensive that he could take care only of the city of Amboina, with the result that the Public Health Service of the rest of the island was neglected. A second government physician in Amboina acted as head of the leprosy campaign and as director of the leprosarium of Amboina, but was not permitted to give any time to problems not directly connected with leprosy. There was also a physician attached to the oil company at Boela in Ceram.

c. Clinics independent of hospitals were found at Amboina, Larat (Tanimbar Islands), Saumlakki (Tanimbar Islands), and Toeal (Kai Islands). In addition, there were several clinics where practical nurses acted as dispensers and where a government physician occasionally came for a check-up. Such clinics were found in Laiwoei (Batjan Islands), Toelehoe (Amboina), Leinator (Saparoea), and Honitetoe (Western Ceram). The problem of medical care on the Tanimbar Islands offered peculiar difficulties, because weather conditions are especially bad.

10. LABORATORIES. Amboina had a special malaria laboratory where blood smears were checked and mosquitoes were identified. Reports were forwarded to the government physicians who had sent the specimens. Three mantris worked in this laboratory. The nearest general diagnostic laboratory was at Makassar in Celebes. In 1938 the physicians at Djailolo in Halmahera and at Laboeha in Batjan (two foci of dysentery) were reported to be equipped with a stock of glycerine tubes in which specimens could be sent to Makassar. Wassermann tests were performed in the military hospital at Amboina.

Section III

DISEASE INFORMATION

11. GENERAL. The main diseases of the Molukken Archipelago and the eastern islands of the Banda Sea are malaria, yaws, dysentery, filariasis, leprosy, and skin diseases. In the following paragraphs, the general disease conditions of the area are described. See section IV for details of individual islands.

12. DISEASES OF SPECIAL MILITARY IMPORTANCE. a. Malaria. Malaria is en-

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demic throughout the region, especially in the coastal areas. Pernicious cases and malaria cachexia were, however, rare, and blackwater fever was said never to occur until recent years, when a few cases were described from Ceram. There are only a few islands where malaria is infrequent, as for instance, Saparoea and Noesalaoet of the Amboina Archipelago and the islands of the Banda Archipelago. Malaria is said to be absent from the volcanic isles in the southern part of the latter group. Although specific data as to the distribution of malaria according to strains of the Plasmodium are lacking from this area, one may infer from what is known about malaria elsewhere in the Netherlands East Indies that a high proportion of the infections are due to the estivo-autumnal type. Infection with *P. malariae* is probably rare. Severe outbreaks of malaria often follow the clearing of the forest, unless measures are taken to control breeding of *Anopheles punctulatus punctulatus* and *A. punctulatus moluccensis*, both of which breed in sunlit pools and puddles.

b. Venereal diseases. Syphilis rarely occurred among the natives. It was found mainly among Javanese immigrants and military personnel. Gonorrhea occurred more frequently among the natives. Granuloma inguinale, frequent in southern Dutch New Guinea, was not known to occur in the Molukken Islands.

c. Enteric infections. (1) *Bacillary dysentery.* Although the literature states that bacillary dysentery is rare in the Molukken Islands, this is erroneous. The importance of bacillary dysentery in this area has recently become apparent. Specific information is still sketchy, but several outbreaks have been reported in recent years even from remote parts of the Molukken Islands. As far as is known, dysentery is most frequent in the Tanimbar Islands, Halmahera (Djailolo and Weda), Ternate-Tidore, and the Batjan Archipelago. In view of the high fatality rate, the greater part of these cases are probably due to *Shigella dysenteriae.* Since the occupation by the Japanese, dysentery epidemics have been raging through the internment camps in Amboina.

(2) *Amebic dysentery,* Amebic dysentery occurs everywhere but is not common.

(3) *Typhoid fever.* This disease is said to be rare, but it should be stressed that neither bacteriological surveys nor autopsy statistics are available so that reliance cannot be placed on this estimate.

d. Filariasis. Elephantiasis is seen in many of the Molukken groups. Special surveys have shown that the widespread filariasis on the island of Ceram is due to *Wuchereria malayi*, whereas in the rest of the Molukken Islands and even in nearby Boeroe only *W. bancrofti* has been found. (The latter parasite also prevails in the Southwestern Islands.)

e. Skin diseases. Tinea imbricata is the most frequent skin disease. Other skin conditions due to infections with fungi are also frequent, and scabies, impetigo, and pediculosis capitis occur generally. Tropical phagedenic ulcers are prevalent. Favus is extremely rare.

f. Dengue. Sporadic cases of dengue have been reported among Europeans. For many years no widespread acute outbreak of dengue has been recorded, but there is constant danger of such an outbreak, owing to the widespread occurrence of *Aedes aegypti.*

13. DISEASES OF POTENTIAL MILITARY IMPORTANCE. a. Cholera. For many years no cholera has been reported from this area. The possibility that importation of cholera patients from other areas may lead to an outbreak must be considered. Sanitary conditions are such that widespread dissemination would probably follow its introduction. Between 1937 and 1940 a cholera-like disease was reported from nearby southern Celebes.

b. Mite-borne typhus. Although mite-borne (scrub) typhus has not been described in these islands, it is known to exist in Celebes and New Guinea. Its presence in the Molukken Islands should therefore be suspected until more definite evidence to the contrary is available.

c. Plague. No cases of plague have been reported from the Molukken Islands, although the disease occurred between 1922 and 1930 in Makassar in southern Celebes.

d. Influenza. The epidemic of 1918 took a large toll. Since then no severe epidemics have been reported. Minor outbreaks occur periodically.

14. SERIOUS DISEASES OF NONMILITARY IMPORTANCE BUT LIKELY TO AFFECT SMALL NUMBERS OF TROOPS. a. Yaws. Yaws (frambesia) is so frequent that

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every native may be assumed to have suffered from this disease in childhood. This holds true even for the small islands of the Banda group which are practically cut off from sea lanes. Before the war, about 80,000 neoarsphenamine injections were administered annually to yaws patients on the Molukken Islands. As the greater part of this treatment was not systematically followed, the incidence of the disease did not diminish. Only in Riring on Ceram, where three neoarsphenamine injections were systematically given to every yaws patient at weekly intervals, did the incidence of the disease actually diminish.

b. Leprosy. Leprosy is widespread. It is very common in Amboina, whereas it is relatively rare in the adjacent islands of Boeroe and Ceram and the Banda Islands. In the Kai Islands the disease is common.

c. Smallpox. Until 30 years ago, smallpox was extremely common in the Molukken Islands, but has been virtually stamped out by vaccination despite the fact that in certain areas of Halmahera, Boeroe, and Ceram the native population has been opposed to vaccination. It was generally assumed, however, that a satisfactory part of the Molukken population had been vaccinated. Only in the aforementioned islands and in the Kai Islands was there a substantial unvaccinated population in 1938.

d. Nutritional diseases. (1) It is the general opinion that almost the whole sago-consuming native population of the Molukken Islands is on the verge of developing beriberi. The complete clinical picture was frequently observed in women following childbirth and in infants. An acute infection or incarceration in prison was often sufficient to cause the disease to appear in acute form. About 90 percent of the natives who wanted to enlist in the army had to be rejected, mainly for "beriberi heart." It was almost impossible to obtain the cooperation of the population in the campaign against the disease. Mungo beans distributed free of cost were thrown away, and the natives were unwilling to start the cultivation of vegetable gardens as long as sago was growing all around and could be obtained with a minimum of exertion. In prisons and in hospitals, outbreaks of beriberi were prevented by requiring consumption of vegetables containing vitamin B.

(2) Xerophthalmia and hemeralopia are common.

e. Helminthiasis. Infections with *Ascaris lumbricoides* and with *Ancylostoma duodenale* are widespread throughout the archipelago.

f. Trachoma. Trachoma is prevalent throughout the area. For a long time there was discussion as to whether the eye disease so common in these areas could be trachoma. Some authors were of the opinion that the disease is mainly conjunctivitis granulosa, but in recent years this suggestion has been abandoned.

g. Neither louse-borne typhus nor flea-borne typhus has ever been reported from this area.

h. Scarlet fever. This disease has not been reported.

Section IV

SUPPLEMENTAL DATA ON INDIVIDUAL ISLANDS OR GROUPS OF ISLANDS

15. GENERAL. In this section, islands and groups of islands are arranged from north to south in a general clockwise order.

16. HALMAHERA. a. General. Halmahera and the adjacent islands form part of the northern Molukken Islands. These islands are rough and mountainous with level ground restricted to small, discontinuous areas on the coast and along the larger rivers. All are heavily forested. Important settlements are on the coast. Population is sparse and concentrated largely on the northern peninsula. The islands have a hot, moist equatorial climate; rainfall, varying at sea level from 60 to 110 inches, is well distributed throughout the year, and falls mostly as a steady drizzle during the southeast monsoon (May to October), and as sharp showers during the northwest monsoon (November to April).

b. Water. Abundant water supplies are available from the many perennial streams, numerous springs, and from wells in the alluvial plain and nearby foothills and terraces. Shallow wells already exist at most settlements. Lakes and ponds are uncommon.

(1) Surface water is generally low in mineral content but high in organic products, with decided color and unpleasant odor and taste. Ground water is hard when taken from limestone areas but otherwise is not highly mineralized. Thermal springs may contain sodium

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chloride, hydrogen sulfide, or other compounds which may make the water nonpotable. Some nonthermal springs near the coast are saline. Near the coast of the larger islands and throughout the smaller islands ground water usually is salty at some point below sea level, but a lens of fresh ground water floats on the salty ground water. On some of the smaller islands, particularly coral islands less, than ½ mile wide, all ground water may be brackish.

(2) Sanitation standards are low, and most existing water supplies are polluted. Shallow wells and springs, particularly in limestone areas, are liable to be polluted.

(3) Wells are definitely known to exist in the settlements of Wajaboela and Sangowo (Morotai Island), Galela, Tobelo, and Weda (Halmahera Island), and Katinai (Damar Island). In some settlements, such as Tobelo, practically every house has its own well, but in others one or two wells may serve the whole community. Practically all of the wells are on coastal or river plains, are mostly large diameter dug wells usually less than 40 feet deep. Water generally is raised by buckets and rope, lift pump, or other primitive means.

c. Diseases. (1) *General.* In spite of its size and population (102,000 persons), few studies have been made of disease conditions on Halmahera, nor have government reports contained very precise information. From its location with reference to Celebes, the western end of New Guinea, and the neighboring Molukken Islands, areas about which more precise data are avaliable, one may surmise that disease conditions are probably quite comparable, varying only in intensity.

(2) *Malaria.* Malaria is unquestionably widespread, even though specific reports of such occurrence are not available. Malaria vectors known to be present on Halmahera include *Anopheles punctulatus moluccensis* and *A. punctulatus punctulatus*, the important vectors of New Guinea and the Solomons. It can be expected, therefore, that clearing of the forest with consequent formation of sunlit breeding areas, will result in more extensive spread of malaria unless specific measures are taken to prevent mosquito breeding. *Anopheles kochi* is a vector of secondary importance.

(3) *Mite-borne (scrub) typhus.* Although no references have been made to the occurrence of mite typhus on Halmahera, the entire island should be considered as a probable mite typhus area. The disease is known to occur in the Minahassa section of Celebes (the large northern peninsula) and in the Vogelkop (westernmost) sector of New Guinea. It is safe to surmise, therefore, that the infection exists on Halmahera, even though unrecognized or unreported. The scarcity of medical personnel (three physicians for a population of 102,000 scattered over an area the size of New Jersey) and the lack of laboratory facilities are so great that infections of this character might readily pass unreported.

(4) *Dysentery.* Dysentery is widespread. An outbreak occurred at Djailolo in the middle of 1937. From here the disease spread over southern Halmahera and caused 3,000 cases and 500 to 600 deaths. The mortality was so high that one may assume the outbreak was due to the Shiga bacillus. The Makassar laboratory report of that period states that Shiga bacilli could be cultivated from many of the stool specimens sent in from outside. The epidemic also involved Weda in the southern half of the island. In the first 3 months of 1938, although the disease was on the decline, 72 cases occurred in Topoleo in the Weda area and 30 people died. In August 1938 there were 20 cases reported from Sagea in the same neighborhood. The Dutch authorities relied upon mass vaccination against dysentery. They were of the opinion that no other method could be used, in view of the complete ignorance of the population. All attempts to indoctrinate the population in the use of latrines have failed completely.

Amebic dysentery is also common in Halmahera. An acute outbreak was reported at the end of 1937 from Tobelo and also from Djailolo.

(5) *Filariasis.* The existence of filariasis on Halmahera is certain as several cases of elephantiasis have been described. Beyond the mere fact of the occurrence of this disease, little is known. From analogy with surrounding areas and knowledge of the mosquitoes that exist on Halmahera, one may infer that vectors of major importance include *Anopheles punctulatus punctulatus* and *A. punctulatus moluccensis.* There is no information as to whether

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infection is due to *Wuchereria bancrofti* or to *W. malayi.*

(6) *Leprosy.* In Tobelo and Weda leprosy is frequent. In 1938 there were 70 patients in the Tobelo leprosarium.

(7) *Trachoma.* In Tobelo 108 trachoma patients were discovered among 3,910 persons examined in 1938. Of 47 villages surveyed, only 13 which were isolated and far removed from the island traffic were free of the disease.

(8) *Smallpox.* Although smallpox has been reported to have been absent in recent years, the inhabitants of Halmahera are less well vaccinated than on most islands of the Molukken group. There has been considerable native opposition to vaccination.

(9) *Skin diseases.* Skin diseases, notably yaws, scabies, impetigo, tinea imbricata, and tropical ulcer, are widespread.

17. BATJAN ISLANDS. a. General. The terrain, climate, and water resources are similar to those of Halmahera Island. Wells are definitely known to exist only in Babang (east coast of Batjan Island).

b. Diseases. (1) *Malaria.* These islands are known to be highly malarious.

(2) *Dysentery.* Epidemics occur frequently, the disease usually being introduced from Halmahera. In 1937, 100 patients with bacillary dysentery were reported. Here, as in many other Molukken groups, mass vaccination has been practiced, allegedly with favorable results.

(3) *Filariasis.* Filariasis probably occurs though specific reports of its presence are lacking.

(4) *Leprosy.* Leprosy occurs. In 1938, Laboeha requested the construction of a leprosarium.

18. SOELA ISLANDS. a. General. The Soela Archipelago consists of three large islands and several small ones situated east of Celebes. The three large islands are Sanana (12,000 inhabitants), Mangoli (4,000 inhabitants) and Taliaboe (4,000 inhabitants). The most important of the smaller islands is Lifoematala, east of Soela Mangoli. The highest peak of this group is found on the last-mentioned island (3,500 feet). The capital is Sanana on Sanana. These islands have narrow coastal areas, the mountains starting near the coasts.

b. Water. (1) Water resources of these islands are excellent but undeveloped. The mean annual precipitation ranges, along the coast, from about 70 to 115 inches, increasing to about 150 inches in the higher lands. There are numerous streams. Some larger spring-fed ones are perennial, and there are probably pools on the smaller ones that are replenished by frequent rains. Springs are numerous. Water can be obtained from shallow or drilled wells in coastal areas and from rain water catchments any place on these islands.

(2) The natives use water from streams, springs, primitive shallow wells, and collected rain water. The European inhabitants collect rain water for drinking and culinary purposes. The town of Lekitobi at the southwest corner of Taliaboe Island obtains a considerable part of its supply from springs. No water distribution systems are reported on these islands.

(3) Stream and shallow well water is badly polluted. Spring water is usually somewhat safer but also may be contaminated at times. Properly located and constructed drilled or dug wells in the coastal areas should yield water of satisfactory quality in adequate amounts.

c. Diseases. *Malaria.* Malaria is prevalent. The following spleen indexes were reported in 1923.

	Adults	Children
Sanana	41 percent	55 percent.
Poheija	65 percent	75 percent.
Bega	40 percent	35 percent.

(2) *Yaws.* This area is notorious for yaws, from which 19 to 40 percent of the population are said to suffer. In one village, Fatikayon, 45 percent of the inhabitants have been found to be suffering from this disease.

(3) *Tuberculosis.* Tuberculosis is said to be rare.

(4) *Filariasis.* The scanty data available indicate that this disease is prevalent.

(5) *Smallpox.* Vaccination against smallpox has been effective. Of 1,278 people examined, only 131 had not been vaccinated in 1923.

(6) *Leprosy.* In 1923 it was possible to examine 2,500 of the 10,000 inhabitants of Sanana. Among this group, 8 lepers were found; the total number of lepers on this island was estimated as 40.

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(7) *Skin diseases.* Tinea imbricata is widespread; about 5 percent of the population are infected.

(8) *Trachoma* and a trachoma-like conjunctivitis occur frequently among the children.

19. TERNATE AND TIDORE. a. Water. These islands and the neighboring small islands of the volcanic group have few or no perennial streams, and ground water is the only source for large supplies. Wells are known to exist at Ternate, which has the only water distribution system in the region. Water is pumped from two shallow open dug wells into an open reservoir, where it is chlorinated with caporite. The waterworks is in the same building that houses the electric power station and the ice plant. Behind this building is a 12-foot pressure tank. The system serves only a small part of the population, but extends to the main pier. In 1940 water could be supplied to ships at a rate of 175 gallons a minute (40 metric tons per hour). The balance of the population is served by private and community wells. The supply is said to have become low at times of unusual drought.

b. Diseases. *Malaria.* Both islands are marshy and highly malarious. In many villages of Ternate the spleen index varies between 50 and 60 percent.

(2) *Dysentery.* Dysentery is prevalent. At the end of 1938 an outbreak of 67 cases was reported. Vaccination of 2,800 people was said to have checked the epidemic. No fatal cases were reported.

(3) *Leprosy.* Leprosy is common in these areas. In 1938, there were 55 known cases, 22 of which had been admitted to the leprosarium of Ternate.

(4) *Tuberculosis.* Tuberculosis is prevalent.

20. AMBOINA ARCHIPELAGO. a. General. Amboina forms, with the smaller islands of Saparoea, Haroekoe and Noesalaoet, the Amboina Archipelago, which is south of Ceram. Saparoea, Haroekoe, and Noesalaoet are often designated as the Geliasors Islands, although the inhabitants of Saparoea insist that they be distinguished from those of the two other Celiasers islands. The islands are of volcanic origin and are often considered as the northern end of the volcanoes of Banda. No active volcanoes are found in the Amboina group, but earthquakes are frequent.

(1) The inhabitants of the Amboina Archipelago are civilized, and on the whole are well educated. As such they form a separate group, well distinguished from the wild Alfurs who inhabit the surrounding Molukken Islands. The Ambonese are very dark and more hirsute than the Javanese.

(2) Amboina, the largest island of the group, has an area of 320 square miles. It consists of two parts, Hitoe and Leitimor, united by a narrow and marshy strip of land only 1¼ miles broad and 10 feet in elevation. This strip separates the Bay of Amboina from the Bay of Bagoela. Leitimor is smaller but more densely populated than Hitoe. Both parts are mountainous. The alluvial coastal plains are relatively narrow. Here are the malarious sago forests. The population of the island of Amboina amounts to 68,000; the city of Amboina has 17,700 inhabitants. About 60 percent of the inhabitants of Amboina Island are Christians, the rest Moslems. The Christians are westernized; they do not use the Ambonese language but speak Dutch or Malay.

(3) Haroekoe (area, 202 square miles) is largely terraced, but mountainous in the south-central part, with one peak 1,500 feet high. Along the west coast there are narrow coastal lowlands. Elsewhere low cliffs border a narrow beach. Fringing reefs adjoin the north and east coast.

(4) Saparoea consists of two upland areas connected by a broad, low-terraced isthmus. In the central part are small irregular mountain areas rising to 1,000 feet. Lowlands, in part swampy, fringe part of the south and west coast. In other parts there is an abrupt rise from the coast to low terraces. There are few permanent streams and no deep valleys.

(5) Noesalaoet (area, 22 square miles) is covered by hills which come near the coast. The population amounts to about 6,000, all Christians.

(6) The small island of Molana south of Saparoea rises steeply to a ridge of about 500 feet high, except on the north where the ridge grades to a small coastal flat.

(7) The average annual rainfall in the Amboina group is about 140 inches, with a monthly maximum of about 25 inches in June. The west

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monsoon is dry, the east monsoon wet. Average rainfall in Amboina and Saparoea is shown as follows:

Rainfall (inches)

	Amboina	Saparoea
January	5. 4	4. 4
February	4. 8	4. 4
March	5. 2	5. 0
April	11. 0	7. 2
May	20. 7	20. 0
June	25. 2	26. 4
July	24. 0	24. 3
August	17. 0	16. 7
September	9. 6	10. 0
October	6. 4	7. 5
November	4. 8	4. 0
December	5. 6	5. 6

b. Water. Drinking water is plentiful in Amboina and Haroekoe. Rain is profuse, and there are numerous rivers (many perennial) and springs which provide large quantities of water in the rainy season. There are also a few small lakes. With the exception of a few minor settlements on the peninsula of Leitimor all the Ambonese villages are situated on the coast. Only a few Boetonese live in the interior on remote, isolated hills. There is therefore not much contamination in the mountains, and water arriving on the coastal areas is relatively uncontaminated and is drunk without treatment.

(1) Most inhabitants except those in the town of Amboina obtain their water from shallow wells or sumps. Springs and streams are used less frequently. The wells are large diameter dug type, rarely more than 30 feet deep and usually sunk in alluvial deposits on the coastal plains. Water is generally raised by bucket and rope or other primitive means. Some wells near shore go dry at low tide; others yield brackish water. Practically all of these wells are likely to be polluted.

(2) The city of Amboina, population 17,078 in 1930, obtained its water from a spring 3 miles from the city in Koesoe-Koesoesereh and from a well near Liangikan Grotto about 2 miles south of town. The water was chlorinated by means of caporite before it was delivered to the distribution system. This consisted in 1940 of about 14 miles of 12-inch-diameter pipe and supplied 516 private customers, 38 commercial establishments, and 6 public hydrants with a total quantity of 50,800,000 gallons. Water was piped to the main pier and to the coal jetty where it could be supplied at a rate of 7 tons (1,680 gallons) per hour. At one time water was also obtained from impounding dams on the Batoegadjah and Batoegantoeng rivers. This supply may still be connected to the distribution system.

(3) Water supplies, probably derived from wells, also exist at the larger aerodrome at Laha and at the seaplane base at Halong.

(4) Good water is less abundant on Saparoea, Noesalaoet, and Molana where there are very few rivers. The well water, particularly in the coastal area, is often brackish. Adequate supplies can probably be obtained on Saparoea from wells placed far enough inland to avoid salt water contamination, or from wells piercing the limestone of the lower terraces.

(5) On all of the islands of this group there are thermal and mineral springs. Practically all of the thermal springs are strongly mineralized.

c. Insects. Anophelines most commonly found in Amboina are *Anopheles punctulatus punctulatus*, *A. kochi*, *A. barbumbrosus*, and *A. vagus*. In Amboina the dangerous *A. punctulatus moluccensis* breeds not only in sweet water but also in brackish pools. The mosquitoes most frequently found in the city of Amboina are *Anopheles punctulatus moluccensis*, *A. subpictus* (only small number) and *A. insulaeflorum*. The first and the last are especially house mosquitoes. In Saparoea and Noesalaoet *A. punctulatus punctulatus* and *A. barbumbrosus* are common. In Haroekoe the same anophelines are found, and also *A. subpictus*. In all the islands of the Amboina Archipelago *Culex quinquefasciatus* and *Aedes aegypti* are common.

d. Food in relation to health. (1) Sago is the principal food, but neither Amboina nor the Oeliasers islands have sufficient sago crops to satisfy their needs. Every year large groups of the inhabitants of the Amboina Archipelago cross to Ceram to cut down the sago trees at the south coast around Elpapoetih Bay near Makariki. In addition to sago, a large amount of fish is eaten. The Christian inhabitants of Amboina and Saparoca also eat rice, the Moslems a certain amount of corn. The nutrition of the urban population is worse than that of the country villages, since in the city much money is spent for tuition fees and for western clothes, and often not enough is left for food.

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(2) Cattle are very scarce in Amboina. The Moslems have some sheep and goats, the Christians pigs. The amount of poultry is small. The Ambonese did not engage extensively in agriculture. The 3,000 Boetonese who had migrated to Amboina and lived in the mountains had large gardens and sold their produce. These people were completely uncivilized and extremely dirty.

e. Diseases. (1) *Malaria.* The incidence of malaria is variable. Amboina has had very little malaria in recent years. In most of the villages malaria is only moderately common; a spleen index of not more than 3 percent is frequently found. Only the villages of Lima, Koesoe-Koesoesereh, Hila, Islam, and Tawiri are highly malarious. Here the spleen index varies between 41 percent and 75 percent. Malaria was formerly severe at Paso, a village situated on the narrow strip of low land connecting Leitimor with Hitoe. The soil is marshy and is covered with sago forests where *A. punctulatus moluccensis* abounds. Paso, with 618 inhabitants, had a splenic index of 82 percent in 1926 compared with Alang on the south coast of Hitoe, where the splenic index was only 6 percent. As a result of careful sanitation, Paso was practically malaria-free in 1938. Repeated inspection was necessary, however. An acute outbreak of malaria was reported in 1938 from Laha. In Amboina there is no genuine seasonal variation in malaria, although the number of cases increases slightly at the beginning and end of the rainy season. In Haroekoe Island malaria is widespread, but in Saparoea it is very infrequent, and the splenic index of the school children varies between 2 and 3 percent. In Noesalaoet the splenic index of the school children is relatively low (2½ to 6 percent). Every year, however, a certain amount of malaria is introduced into these islands when the inhabitants cross to malarious south Ceram to obtain their sago.

(2) *Venereal diseases.* In the islands of the Amboina Archipelago syphilis has been found among the immigrant Javanese and the military personnel, but not among the natives. Gonorrhea, on the other hand, is more frequent among the native population.

(3) *Bacillary and amebic dysentery.* These occur regularly in Amboina. An epidemic of bacillary dysentery was reported in 1921. In 1942, following the Japanese occupation, a serious epidemic of bacillary dysentery broke out in the internment camp which had been built on this island.

(4) *Typhoid fever.* Typhoid fever occurs regularly in the city of Amboina but is said to be rare in the rest of the island. During 1938 there were 13 cases reported from the city of Amboina and 2 from Saparoea. It is very possible that typhoid fever occurs more commonly than this, for even in Amboina, the center of the Molukken Islands, no facilities for the laboratory diagnosis of typhoid fever exists, and autopsies are rarely performed.

(5) *Skin diseases.* Tinea imbricata, tinea circinata, tinea albigena, and tropical phagedenic ulcers are very common. About 5 percent of the population show extensive lesions of tinea imbricata. This disease is equally frequent in the villages where sulfur springs occur. About 15 percent of the population suffer from pityriasis versicolor.

(6) *Filariasis.* In all the islands of the Amboina Archipelago cases of elephantiasis are seen. Filariasis in this area is due to infection with *Wuchereria bancrofti.*

(7) *Intestinal helminthiasis.* Almost all children have Ascaris infection. Hookworm disease is widespread, especially in Saparoea. Often 50 percent of the hospital patients on this island are admitted for ancylostomiasis.

(8) *Tuberculosis.* Tuberculosis is common throughout the Amboina Archipelago. In Saparoea the disease is especially widespread. Unfortunately, many Ambonese, educated as school teachers, are instrumental in the dissemination of tuberculosis throughout the Molukken Islands. In 1932 a general survey showed that 64 percent of Ambonese children of 13 years had a positive von Pirquet reaction. The largest number of positive reactions was found among the inhabitants of the city of Amboina and the coastal villages. Conditions among the mountain population were somewhat better. A survey of the island of Amboina which was made in 1932 without the help of X-ray equipment showed that 1.9 percent of the inhabitants had active tuberculosis. The tuberculosis mortality rate for the whole island was 227 per 100,000; but in the mountain villages the rate was only 65 per 100,000. Plans

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for a public sanitarium were completed in 1938.

(9) *Bronchospirochetosis* has been reported in Amboina but has not been confirmed. Available evidence indicates that most of the hemoptyses in Amboina are of tuberculous origin.

(10) *Influenza.* Influenza epidemics are frequently reported. The etiological diagnosis of influenza has, of course, been impossible. It seems probable that many respiratory tract infections of diverse etiology have been reported under the designation of influenza. The east monsoon is commonly chilly, and during the rainy season the night temperature may drop sharply. As the poorly constructed, atap houses do not sufficiently protect against these climatic changes, respiratory infections commonly develop during this season. The insufficient protection of the houses against drafts has been considered a factor in the frequency of the rheumatoid pains which afflict so many of the older Ambonese.

(11) *Leprosy.* Leprosy is unusually common in the Amboina Archipelago. In 1922 there were 265 known lepers on Amboina Island; in 1931 this figure was 825, and in 1938 it was 350. The center of the disease was in the city of Amboina, where 0.56 percent of the population was estimated to be infected in 1931. The more remote the villages, the lower the rate (fig. 1). The villages of the Leitimor peninsula are the most heavily infected. In two of these villages, Amahoesoe and Lata, 1.1 percent and 1.16 percent of the population was infected in 1931. By contrast, most of the villages on the Hitoe peninsula of Amboina were free from leprosy. In Saparoea 51 cases were found in 1901. In 1929 this number had increased to 88, in 1937 to 115. The number of lepers in Noesalaoet was 12 in 1901 and 6 in 1923; in Haroekoe there were 25 lepers in 1901 and 40 in 1923. The people take no precaution against leprosy; lepers live together with healthy members of their families. Often healthy families with children adopt a leprous child. There is a large leprosarium in Amboina with 215 patients.

(12) *Smallpox.* Smallpox had been frequent until 30 years ago but has been stamped out by vaccination. In Christian villages vaccination has been especially popular. During a recent survey only 11 pock-marked people were found among 4,538 Christians, while in the Moslem villages 185 were found among 4,249 people.

(13) *Beriberi.* Beriberi is common, especially in Saparoea. The incidence varies constantly from year to year. In 1936 beriberi was prevalent among the women and children of this island but was less common in 1937.

(14) *Yaws.* In all islands of the Amboina Archipelago yaws is very frequent. In Amboina mutilating rhinopharyngitis is not uncommon. Although neoarsphenamine treatment has been very popular, parents hardly ever permit children with initial lesions of yaws to be treated as they believe that treatment should not begin until ulcers, so-called boba, have developed.

(15) *Trachoma.* Trachoma or a conjunctivitis very similar to trachoma, is widespread among the school children of Amboina. About 20 to 40 percent of the children are affected.

(16) *Tetanus.* Tetanus is rare.

21. CERAM. a. General. Ceram, or Seran, has an area of 7,200 square miles. The total population is about 70,000; this figure is only approximate because the number of the wild Alfurs who live in the interior can only be estimated. In western Ceram there are 31,000 people. The island is covered with very extensive sago forests. At the same time there are wide fertile plains suitable for coconut palms. The excellent soil can be irrigated for the cultivation of rice. Large rivers run north and south. A high mountain chain running from east to west divides Ceram into northern and southern parts which have completely different climates. On the north coast the west monsoon (December to March) brings rain, and the southeast monsoon (June to November) is dry. On the south coast conditions are the reverse, the southeast monsoon bringing rain while the west monsoon is dry. The only exception is a small part of the southern coast extending westward from the village of Kaibobo between the peninsula of Hocamoet and Piroe Bay. On this part of the south coast, the climate is identical with that of the northern coast. This remarkable contrast is due to the high mountains on nearby Amboina, which cause the moisture of the southeast monsoon to be precipitated on this part of the south coast of Ceram. On the north coast of Ceram and on the south coast west of Kaibobo

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rice is planted in December and January, but on the rest of the south coast, in Hatusua, for instance, this is done in June and July.

(1) The following figures show the average rainfall on the north coast and the south coast of Ceram:

	Wahai (north coast)	Amahai (south coast)
January	12.4 inches	4.5 inches.
February	16.6 inches	4.2 inches.
March	12.7 inches	5.6 inches.
April	8.1 inches	8.1 inches.
May	6.1 inches	13.8 inches.
June	4.8 inches	15.1 inches.
July	4.1 inches	16.9 inches.
August	3.5 inches	16.2 inches.
September	3.2 inches	9 inches.
October	3.9 inches	6.1 inches.
November	4.4 inches	4.3 inches.
December	8.2 inches	4.3 inches.
Total	88.2 inches	108 inches.

(2) All dwellings of the native population are built on poles. In western Ceram the houses are small, but in eastern Ceram many families live in a single house so that a village often consists of only a few large family houses. Head hunting, once a common practice in Ceram, has been eradicated with difficulty.

b. Water. (1) There is usually an adequate quantity of water available from streams and shallow wells, but drought may occur occasionally, as in 1940–41, when it was necessary to import water for Boela from outside Ceram. Native inhabitants of interior villages depend mainly on nearby streams, but there are also many springs. Several rivers in the northwest part of Ceram disappear into the cavernous limestone to become subterraneous streams for distances of 2 or 3 miles before reappearing at the surface as springs. Existing supplies at many of the larger coastal settlements are obtained from shallow wells, some of which are curbed with concrete. In addition nearly all houses that have galvanized iron roofs are equipped to catch rain water for domestic use. Wells dug in the alluvial sand and gravel at the principal coastal villages usually afford water supplies of low mineral content and fair sanitary quality. Some coastal wells, if overpumped, will deliver salty or brackish water. Boela at the northeast end of the island has a supply taken from drilled wells and also from an intake on a small river west of town. There is also a small water supply in Riring, which is stated to need improvement.

(2) Although the Alfurs in the interior mountainous areas do not defecate into the rivers, some fecal material is washed into the rivers. There is considerable dilution of this material in the rivers and the water is therefore somewhat less contaminated than in other primitive areas. All water, however, from whatever source, must be considered unsafe for drinking unless treated.

c. Mosquitoes. *Anopheles punctulatus punctulatus* and *A. punctulatus moluccensis* are the principal malaria vectors. Other possible vectors are *A. subpictus*, *A. barbumbrosus*, and *A. vagus*. In addition, *A. ludlowii* (syn. *sundaicus*) has been captured in Ceram near Piroe, the only place in the Netherlands East Indies where this species has been observed.

d. Diseases. (1) *Malaria.* Piroe, the capital of Ceram, is highly malarious owing to an adjoining area of sage marshes, 10 square miles in area. In Passinaro and Wetoli, situated in the subdivision of Piroe, the spleen indexes have been found recently to be 90 percent and 98 percent, respectively; in Honitetoe, east of Piroe and inland, the spleen index was 43 percent. In the subdivision of Riring, 30 miles northeast of Piroe, malaria is severe in the coastal areas but less severe in the mountains. Although the average figures for the spleen index in this region varied between 20 and 30 percent, in some hamlets the rate was as high as 74 percent. In Wahai on the northern coast the index was only 17 percent. In Amahai on the southern coast, explosive outbreaks of malaria were reported in 1938. Boela in northeastern Ceram, where the large oil wells are situated, is very malarious. Somewhat old but probably still typical are the data in the following table:

Eastern Ceram (1923)

	Spleen index percent	
	Adults	Children
Atiahoe	57	64
Elnoesa	47	55
Werinama	20	36
Batoeasa	55	72
Joekbib	61	95

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In recent years many villages in eastern Ceram have shown a splenic index of 100. Here the children look haggard and anemic with thin arms and legs and swollen abdomen due to splenomegaly. Blackwater fever is reported to occur in Amahai on the south coast.

(2) *Filariasis.* Filariasis is common in some areas and rare in others (see fig. 2). Of 1394 persons examined in north Ceram about 1933, 6 percent were found to have elephantiasis and 12 percent to have microfilariae in the peripheral blood. Figure 2 gives detailed data as to the prevalence of filariasis along the north central coast. Although comparable specific data are not available for the south coast, this area must be considered as equally involved. With a rare exception (possibly imported) *Wuchereria malayi* is the only form of filaria found in Ceram, whereas in nearby Boeroe and in the Amboina Archipelago only *W. bancrofti* occurs.

(3) *Intestinal infections.* Although reports of 20 years ago stated that bacillary dysentery was rare, the disease is recognized today to be common in Ceram. Amebiasis occurs regularly. In Geser, for instance, several cases are reported every month. Hookworm infection is common; in Riring it is said to be of a particularly serious character.

(4) *Typhoid fever.* Typhoid fever is said to be almost unknown, but this statement must be taken with reserve, in view of the lack of facilities for accurate diagnosis.

(5) *Skin diseases.* About 30 percent of the population have been reported suffering from tinea imbricata or "cascadoe." One of the main centers of the disease is Atiahoe. Scabies, tropical ulcer, and impetigo are nearly as common as cascadoe.

(6) *Venereal diseases.* Gonorrhea is a frequent ailment, but syphilis is encountered only in the neighborhood of foreign and military settlements.

(7) *Yaws.* Yaws or *boba* is general and frequently leads to mutilating rhinopharyngitis, especially in eastern Ceram.

(8) *Leprosy.* Leprosy is relatively rare. In an eastern area, with a population of about 10,000, only 2 lepers could be discovered in 1931, but in the small island of Geser, southeast of Ceram, 6 lepers were found among a total population of 556. In eastern Ceram 17 leprosy cases were known in 1938. In western Ceram leprosy patients were seen only occasionally.

(9) *Smallpox.* Smallpox had been common until recent decades. Since then, extensive vaccination has protected the population. The danger of introduction of the disease has always existed, however, because the wild Alfurs could not always be reached. For example, in 1926, of 666 persons examined, 210 were not vaccinated. The extent of vaccination has probably increased in recent years.

(10) *Tuberculosis.* This disease is widespread. No exact data as to incidence are available.

(11) *Diphtheria.* Diphtheria was formerly said to be rare, but in recent years the infection has been frequently recognized. Although measles is said to be almost unknown, this statement is open to question. If it is correct, a disastrous outbreak may be expected among the native population if the disease is once introduced.

(12) *Nutritional disease.* The nutritional condition of the Alfurs of the mountain areas is much better than that of the natives of the coastal regions where sago constitutes the chief article of diet. Gardens are rare, especially on the south coast, where bananas are scarce and no rice is eaten. This explains the frequency of beriberi in the coastal districts of Ceram. For years it was thought that the prevailing form of the beriberi of these sago eaters consisted of polyneuritis, whereas the wet form of the beriberi was said not to occur. In recent years, however, the frequency of beriberi heart among sago eaters has been emphasized. In 1937 beriberi was especially frequent on Amahai on the south coast.

	Rainfall (inches)
January	8.8
February	8.4
March	9.2
April	8.6
May	8.6
June	8.0
July	7.0
August	4.9
September	2.4
October	1.9
November	3.1
December	8.0
Total	75.0

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(13) *Alcoholism and drugs.* Addiction to sagoweer, often called sageroe, is very common, especially in western Ceram. One of the centers for this addiction was in the village around Piroe where the men retired regularly into the forests in order to enjoy their alcoholic intoxication without interference. Only in southeastern Ceram was a certain amount of opium addiction found.

22. BOEROE. a. General. The island of Boeroe is situated west of Amboina and Ceram, from which it is separated by the Strait of Manipa, also called the Straits of Boeroe. The island has an area of 3,500 square miles and is inhabited by about 20,000 persons. It is surrounded by coral reefs. Only at the northeast corner in the Bay of Kajeli is a safe anchorage to be found. Here is situated Namlea, the capital of the island. A mountain chain runs from north to south; the highest peaks are the Tanalo and the Siel, 8,000 feet high. There are several mountain lakes, the largest of which is the lake of Wakollo situated at a height of 3,500 feet. There are many small rivers; the only important one is the Wae Apoe or Kajeli River, which can be navigated by small proas. Along the rivers are large marshes covered with sago palms. On northern Boeroe the west monsoon brings rain, while the east monsoon is the dry season. In southern Boeroe conditions are reversed. Boeroe is inhabited by a special tribe of Alfurs who are exceptionally peaceful. As far as is known, no head hunting has occurred on this island. The dwellings are unsanitary. Often three to four families live in a single small house. The following figures show the average rainfall near the Bay of Kajeli:

b. Water. An adequate water supply is readily available, or can be developed in most parts of Boeroe from perennial streams, springs, and wells. In practically all areas of deficient surface water (north and west coasts) adequate ground water supplies can be developed readily. The surface water is low in mineral content, turbid during the rainy season, and relatively clear at low water stage, but often has a decided color and taste because of the dissolved and suspended organic matter. Springs are probably numerous in many parts of the island. The majority are probably cold. Only two thermal springs are reported. The depth to ground water ranges from a few feet along perennial streams to 300 feet or more beneath the higher benches or hills. Part of the ground water is available as "perched" ground water. Settlements on the coastal plain or river plain probably obtain their supply from dug wells rarely deeper than 30 feet and raise it by bucket and rope or other primitive means. Some of the shallower wells may go dry during periods of excessive drought. A few wells within a short distance of the sea yield brackish water, and others will do so if too heavily pumped. At Nam'lea water is obtained from shallow pits or wells sunk in the unconsolidated alluvium sediment underlying the town. All well water is probably highly contaminated.

c. Diseases. (1) *Malaria.* Malaria is very common, especially in the marshy areas. The Alfurs always live near a river, if possible on the edge of a marshy patch. In the dry season of 1939 in most of the villages in the marshy areas of the Wae Apo basin, a spleen index of 25 percent was found. The index was lower in the drier sandy areas but rose during the rainy season. Leksoela in southwestern Boeroe and Waploe on the northeastern coast were very malarious (spleen index 45 percent, parisite index 57.5 percent). In both villages large marshy areas due to silting of the river mouths were a factor in the high malaria rate. Tifoe on Boeroe just west of Leksoela was much healthier. In 1938, cases of blackwater fever were reported from Leksoela. The possible malaria vectors found in Boeroe are *Anopheles punctulatus punctulatus*, *A. punctulatus moluccensis*, *A. barbumbrosus*, *A. subpictus*, *A. umbrosus*, *A. kochi*, and *A. vagus*. Although no definite evidence is available, it can be assumed that *A. punctulatus moluccensis* is the most active vector.

(2) *Filariasis.* Filariasis is widespread in Boeroe and has been carefully studied in the plains of the Wae Apo (see figure 3). Of 832 people examined, 425 showed the presence of *Wuchereria bancrofti* and 40 had *elephantiasis.*

(3) *Yaws.* Yaws is widespread, so much so that the people believe that everyone has to suffer from this disease. Older people often show mutilating scars.

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(4) *Leprosy.* This disease appears to be rare. In the surveys of 1923, 14 villages inhabited by 3,000 people were visited, but no cases of leprosy were encountered.

(5) *Tinea imbricata* or *cascadoe* is widespread. About 30 percent of the children are infected. In some villages the percentage is as high as 50.

(6) *Other diseases.* Venereal disease, tuberculosis and trachoma are said to be rare. In olden times Boeroe was notorious for smallpox. As a result of vaccination the disease disappeared about 1920.

(7) *Nutrition.* The nutritional condition of the Alfurs living in the interior mountainous areas is worse than on the coastal areas. Beriberi occurs frequently. A severe outbreak was reported in 1937 from Waplace in northern Boeroe. In the mountains goitre is common, especially around the Lake Rana. Boeroe is one of the few islands of the Molukken groups where goitre is known to occur.

23. THE BANDA ISLANDS. a. General. The Banda group consists of 10 islands, of which the more important are Banda Neira, Great Banda or Lontar, Goenoeng Api, Ai, Roen, and Rozengain. The total area is about 21 square miles and the population is 10,000. To the Banda group also belong the small volcanic islands of Seroea (400 inhabitants), Nila (850 inhabitants), and Teoen (900 inhabitants), which lie far south of Banda Neira. The main islands of the Banda group are famous for the cultivation of nutmeg which is concentrated in this little archipelago. The best quality of nutmeg is found on Roen and Rozengain.

b. Water. Although the Banda Archipelago has a rainy climate, no rivers or brooks are found except in Lontar. The rain disappears too rapidly in the loose volcanic soil to form rivers. The people rely mainly on rain water, but also use condensed steam from the volcano craters on Nila, Teoen, and Seroea. The population consists of the descendants of slaves transported to these islands from other parts of the Molukken Islands. On the smaller southern islands the main food is bananas. The average annual rainfall is shown in the following table:

	Rainfall (inches)
January	10. 2
February	8
March	8. 8
April	13. 2
May	15. 9
June	14. 7
July	8. 4
August	4. 5
September	4. 9
October	4. 6
November	5. 4
December	9. 7
Total	108. 3

c. Diseases. The islands of the Banda Archipelago were almost free from malaria at the time of the Japanese invasion. Malaria occurred very infrequently in the Banda Islands proper and was nonexistent in the three southern volcanic islands. Leprosy was also relatively rare. Nila seems to have been free from the disease, whereas in Banda about 20 cases were known in 1938. The leprosarium in Banda had 14 patients. Yaws was extremely frequent as was also tinea imbricata. Specific data on other diseases are not available.

24. KAI OR EWAB ISLANDS. a. General. (1) The Kai Islands, lying between the Banda and Aroe Islands, have a total area of 520 square miles. There are about 52,000 inhabitants. The main islands are Great Kai or Noehoe Yoet, Little Kai or Kai Doela (Noehoe Roa), the Tayando group, and the Koe group. Great Kai, 164 miles long, is mountainous and wooded, and its coasts consist of steeply rising cliffs. Several mountain peaks reach 2,400 feet. The other Kai Islands are much lower; even the hills in the western part of Little Kai are not higher than 300 feet. The lower Kai Islands are also covered by forests. On Great Kai, which has a limestone formation, many small rivers are found on the east and west coast, but these dry up during the east monsoon. In the other islands the people must rely on dug wells. The capital of the archipelago is Toeal, situated in a small valley of Little Kai. Nearly all the villages are situated in the coastal areas. In Great Kai there are also about six mountain villages, in Little Kai only one. Sago forests are found everywhere, especially in Great Kai and on the marshy south coast of the islands belonging to Little Kai. Coconut palms, areca

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palms, and maize are found, but on the whole the soil is not fertile. The people rely chiefly on sago and cassava for food.

(2) The average rainfall is shown in the following table:

	Rainfall (inches)
January	13. 6
February	10. 5
March	12. 7
April	10
May	8. 4
June	5. 8
July	5. 1
August	3. 1
September	2. 2
October	3. 6
November	6. 5
December	12. 2
Total	93. 6

b. Diseases. Specific data are lacking. Malaria is said to be widespread, although no data are available regarding anophelines. From comparison with other nearby islands, one may assume that *Anopheles punctulatus moluccensis* is the chief vector. Yaws and tinea imbricata are common. An outbreak of amebic dysentery has been reported. Leprosy is more common than in many of the other islands of the Banda Sea. Of 15,697 people examined in the Kai Islands in 1936, there were 105 who suffered from leprosy. The disease was much more frequent in Great Kai, where 0.93 percent of the population was infected, than in Little Kai, where the infection rate was 0.3 percent. The disease prevailed in Little Kai along the southeastern and northeastern coast. In Great Kai all the coastal districts were affected. Here the central mountain villages also harbored many lepers. In the mountain villages of Waoer and Ngefoeit, 8.2 and 17.4 percent of the population were lepers. In 1938 there were 140 known leprosy patients on the Kai Islands. A leprosarium is situated on the Bay of Elat.

25. AROE ISLANDS. a. General. The Aroe Archipelago, the easternmost group of the Molukken Islands, consists of 5 large and about 80 small islands with a total area of about 2,200 square miles. The islands are Warialaoe, Kola, Wokam, Kobroor, Maikoer, Koba, and Tarangan. The capital is Dobo. The islands are covered with sago forests. The fauna shows Australian characteristics, as cassowaries and birds of paradise abound.

b. Water. Water is scarce and unpalatable on some of the islands. The climate is characterized by prolonged droughts. The following figures are given for the average rainfall in Dobo:

	Rainfall (inches)
January	11. 0
February	11. 2
March	8. 6
April	7. 9
May	6. 2
June	5. 7
July	5. 3
August	3. 2
September	3. 1
October	4. 3
November	6. 6
December	9. 5
Total	82. 1

c. Diseases. Although these islands have always been reputed to be unhealthful, especially during the southeast monsoon when beriberi and fevers prevailed, malaria is less frequent in the Aroe Islands than in most of the Molukken Islands. In most villages the spleen index is below 10 percent; only exceptionally has an index of 20 percent been found. In Dobo, the capital, the spleen index was 12 percent in 1938. Dobo is built around a large lagoon; continuous care has been necessary to keep open the communication between this lagoon and the ocean. Cases of beriberi are found in almost all villages. In 1938 many cases were reported from the neighborhood of Dobo. In Koba Dangar, near Dobo, 8 percent of the population had beriberi. An explosive outbreak of beriberi was reported from Kojdjabi. Leprosy is rare; in 1938 only seven cases were known. In 1937 a new leprosarium was opened in Dobo, but it had only four patients in 1938. Yaws is less common than in most islands of this area.

26. TANIMBAR ISLANDS. a. General. (1) The Tanimbar Archipelago consists of 66 islands with a total area of 2,100 square miles. The most important of the Tanimbar Islands are Jamdena (100 miles long), Selaroe, Larat, Fordate, Moloe, and Seira. The islands consist of limestone and young coral and are uniformly less than 600 feet high. There is only one hill on the little island of Laibobar which is

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1,200 feet high. The 40,000 inhabitants of the Tanimbar Islands (also sometimes designated as Timorlaoet) are Alfurs, who resemble the inhabitants of western Ceram. They were formerly fierce head hunters and cannibals. It has been difficult to eradicate these practices.

(2) At present all the villages are situated on the coast. Formerly they were built in the hills, but since the intertribal wars have been stopped, it has become unnecessary to live in fortified hill villages. In the interior of the larger islands are extensive marshes.

b. Water. Water is scarce and unpalatable on some of the islands. The average annual rainfall in Saumlakki, the capital of the Tanimbar Islands, is given as follows:

	Rainfall (inches)
January	11. 7
February	9. 7
March	8. 3
April	5. 4
May	9. 8
June	4. 0
July	2. 7
August	0. 4
September	0. 2
October	1. 5
November	3. 1
December	8. 2
Total	65. 2

c. Diseases. For many years these islands have been reputed to be unhealthful. The water was said to be "bad," and fevers and skin diseases were common. Malaria occurs frequently. In 1923 the splenic index of the children varied between 54 and 87 percent, of the adults between 31 and 65 percent. In 1938 the district of Larat was found to be highly malarious. No data are available as to probable vectors. In recent years these islands have been found to be heavily infected with bacillary dysentery. In 1937 an acute outbreak of 500 cases with 40 deaths was reported. At that time nearly the whole population was immunized. In 1938 only sporadic cases of dysentery were reported. Yaws is widespread. Leprosy is common; in 1938 about 50 cases were known. There is a leprosarium in Saumlakki to which 40 patients were admitted. The natives exclude lepers from their villages, but make no provision for their care. Elephantiasis has been reported from Saumlakki and Larat. Filariasis can be assumed to be present, although no filaria studies have been reported. Tuberculosis occurs but is said to be uncommon. The people are well protected against smallpox. Of 637 persons examined recently, only 51 were not vaccinated.

Section V

SUMMARY AND RECOMMENDATIONS

27. HEALTH AND SANITATION. a. Diseases. The principal diseases of military importance in the Molukken Islands and the eastern islands of the Banda Sea are malaria, the intestinal infections (including bacillary dysentery, amebic dysentery, and typhoid fever), filariasis, venereal diseases, skin diseases, and dengue. Cholera has not been reported in recent years, but would spread rapidly if it were introduced. Between 1937 and 1940 a disease resembling cholera was reported from nearby southern Celebes. Miteborne (scrub) typhus, also known as tsutsugamushi, has not been reported, but is known to exist in Celebes and New Guinea. Diseases of less importance to military personnel are yaws, leprosy, smallpox, intestinal helminthiasis, beriberi, and trachoma; these all occur commonly among the natives.

q. Recommendations. In addition to those precautions ordinarily carried out for military forces, the following recommendations are considered to be of special importance:

(1) *Water.* All water on these islands from whatever source must be considered to be contaminated, and proper treatment should be applied before the water is used. Ice made from untreated local water supplies should be considered unsafe for use in drinks

(2) *Sewage.* Plans must be made for local disposal of sewage and other wastes. In view of the prevalence of enteric diseases, special attention must be given to the careful disposal of sewage by approved methods in order to guard against pollution of water and soil and access of flies. Native employees must be provided with their own toilets and must be compelled to use them.

(3) *Malaria control.* Because of the vital importance of malaria (and the secondary importance of dengue and filariasis), careful plans for mosquito control should be prepared before troops embark for any part of this area. Such

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plans should provide for specially trained personnel, antimalaria supplies, and indoctrination of all troops in preventive measures. Specific control measures should include:

(*a*) Use of bed nets issued as individual equipment at the port of embarkation and thus available for use immediately upon arrival until proper screening of buildings and barracks has been accomplished.

(*b*) Use of head nets, gloves, and other protective clothing where indicated.

(*c*) Liberal use of insect repellents.

(*d*) Proper selection of camp sites. Camp sites should be chosen preferably 1 or 2 miles from important breeding places and from native habitations, barns, and cowsheds, so as to be beyond the effective flight range of mosquitoes. Stream banks should also be considered as possible storehouses of infected malaria carriers. Sites should be selected so that native villages are not on the windward side of the camp, and doors of all buildings should open away from the wind, if possible. If, for military reasons, it is necessary to make permanent camp sites in areas close to villages, consideration should be given to moving these villages to other locations.

(*e*) Thorough screening of all quarters, not merely of those to be occupied in the evenings or at night. Entrance vestibules with a screened door at each side (mosquito lock) will be necessary to exclude the mosquitoes. Strict avoidance of outdoor moving picture shows is essential.

(*f*) Use of sprays in native habitations within mosquito flight range of camps (1 to 2 miles) and in all tents, barracks, mess halls, recreational, and other buildings.

(*g*) Although antimalarial measures may have to be varied according to the specific area and the vector that is locally important, careful clearing and draining of ditches and gutters is necessary in *all* malarious districts. Fish ponds are dangerous breeding places. Salt water fish ponds and lagoons must be drained or connected with the ocean in order that the tide may enter freely. Fresh water fish ponds should be cleaned or drained. The same must be done to fish ponds in rice fields. Rice fields should not be in continuous cultivation. Sufficient time should elapse between crops to permit complete drying of the fields. Oiling of salt water lagoons is usually unsatifsactory because of prevailing winds. The results with paris green are apt to be better, but this material must be applied once every week.

Special attention should be given to stagnant waters, especially those which occur in forest areas recently cleared but inadequately drained. Areas which are cleared should be drained meticulously.

(*h*) Adequate supplies of antimalarial drugs sufficient for 100 percent suppressive treatment should be available for use everywhere in this area and should be employed at the discretion of the surgeon.

(4) *Filariasis.* Filariasis occurs widely in this area. The chief vectors are *Anopheles punctulatus punctulatus* and *A. punctulatus moluccensis.* It is believed that *Culex quinquefasciatus* (syn. *fatigans*), which is an active vector of *Wuchereria bancrofti* in other parts of the world, does not act as an effective vector in this area. *A. punctulatus punctulatus* breeds in stagnant water, especially in artificial collections. Such collections should be emptied, drained, or treated with larvicides. *A. punctulatus moluccensis* breeds in a wide variety of clear, turbid, stagnant, or flowing waters and must be treated in each area according to local conditions.

(5) *Dengue.* Under ordinary conditions the mosquito-control measures recommended in (3) above will be of assistance in the control of dengue. In addition, the policing of buildings and grounds and the regular inspection of water containers will be necessary. It will be remembered that *Aedes aegypti* frequents small collections of water such as vessels and gutters in and around human habitations.

(6) *Venereal disease control.* Venereal diseases are prevalent, sexual contacts easily made and the native population little disturbed if signs of these ailments develop. Venereal disease programs with comprehensive educational campaigns and adequate recreational facilities for troops are urgently necessary. Large supplies of approved prophylactic materials should be provided, and prophylactic stations should be easily accessible to all troops. Contacts with the local health authorities aiming to increase the opportunities for treatment of civilians may sometimes be advisable.

(7) *Food.* If local eating establishments are used by military personnel, thorough inspec-

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tion of these places, including those vending soft drinks and dairy products, should be carried out. Even in these establishments, however, raw fruits and vegetables should be avoided. Troops should be cautioned as to the dangers of eating in unapproved establishments or in native homes. Because of the high incidence of intestinal infections, unusual care must be exercised in the collection, storage and preparation of food in Army mess and post exchanges. Kitchens and mess halls should be carefully screened. The presence of native food handlers about Army messes should be considered as a potential danger. If their help cannot be avoided, their number should be maintained at a minimum, those so employed should be carefully selected by physical and bacteriological examination in accordance with Army regulations, and strict discipline maintained as to cleanliness of person.

(8) *Control of rickettsioses.* Mite-borne (scrub) typhus, also known as tsutsugamushi, has not been reported from the Molukken Islands, but is known to occur in Celebes and New Guinea. As seen in New Guinea, the disease occurs especially in workmen and soldiers who have been clearing grassy areas (kunai grass), since mites live in the moist zone at the base of the grass stalks. All prospective camp sites should be thoroughly cleared of grass and the areas burned over before they are occupied. As far as possible, native laborers should be used for clearing. In New Guinea infection has not been found in the deep jungle. Liberal use should be made of available insect repellents. The current Army typhus vaccine does not protect against scrub typhus. Special attention should be given to bathing and to inspection of the lower parts of the body, especially after men have been in grassy land. Troops in these areas should be cautioned as to the importance of protective clothing, that is, trouser legs should be tucked into boots and long sleeves should be worn.

(9) *Cholera.* Although cholera has not occurred in this area for several years, under present conditions the disease would spread rapidly if introduced. In neighboring areas a few cases have occurred. A cholera-like disease is endemic in southern Celebes. The procedures outlined in previous paragraphs for the protection of food and water are applicable. Immunization is required and in areas where cholera cases occur stimulating doses may be necessary periodically.

(10) *Skin diseases.* Serious infections often follow minor wounds. All personnel should be

Table I.—Government medical personnel in the Molukken Islands and islands in eastern part of Banda Sea

	Public health physician	Military physician acting as public health physician	Indonesian nurses or mantris	Vaccinators
1. Djailolo (Halmahera)	1	0	1	1
2. Kaoe (Halmahera)	0	0	1	0
3. Tobelo (Halmahera)	1	0	1	1
4. Weda (Halmahera)	1	0	1	1
5. Labocha (Batjan Island)	1	0	1	1
6. Sanana (Soela Island)	1	0	1	1
7. Ternate	0	1	2	1
8. Tidore	0	0	0	1
9. Amboina	[1] 1	1	[2] 5	2
10. Saparoea	1	0	0	1
11. Amahai (Ceram)	1	0	0	1
12. Geser (Ceram)	1	0	1	2
13. Honitetoe (Ceram)	0	0	0	1
14. Piroe (Ceram)	1	0	1	2
15. Riring (Ceram)	1	0	1	0
16. Wahai (Ceram)	1	0	0	1
17. Namlea (Boeroe)	1	0	1	1
18. Banda	1	0	0	1
19. Tocal (Kai Island)	1	0	1	1
20. Dobo (Aroe Island)	1	0	1	1
21. Larat (Tanimbar Island)	0	0	1	1
22. Saumlakki (Tanimbar Island)	1	0	1	1

[1] For the antileprosy campaign.
[2] 3 of whom worked in the leprosarium.

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impressed with the necessity for giving immediate first-aid treatment to all wounds, burns, abrasions, and insect bites regardless of size and apparent harmlessness. Daily bathing is highly desirable where water supplies make this possible. Thorough drying of all skin folds (toes, crotch, scrotum, armpits, groin) is imperative for the prevention of fungus infections. Army issue foot powder should always be applied after the bath.

Table II. Anophelines found in the Molukken Islands and Islands in eastern part of Banda Sea [1]

	Halmahera	Ternate	Batjan Island	Amboina	Saparoea	Ceram	Boeroe	Soela	Banda	Kai	Aroe	Tanimbar
A. aitkenii aitkenii	−	−	−	+	−	+	+	−	−	−	−	−
A. albqtaeniatus	+	−	−	−	−	−	−	+	−	−	−	−
A. barbumbrosus	+	−	−	+	+	+	+	+	−	−	−	−
A. hyrcanus	−	+ (?)	−	−	−	−	−	−	−	−	−	−
A. insulaeflorum	−	−	−	+	+	+	−	+	−	−	−	−
A. kochi	+	+	−	+	+	+	+	+	−	−	+ (?)	−
A. longirostris	+	+	−	−	−	−	+	−	−	−	−	−
A. maculatus	−	−	−	−	−	−	−	−	−	−	+ (?)	−
A. minimus minimus	−	−	−	−	−	−	−	−	−	−	−	−
A. parangensis	−	+	−	−	−	+[3]	−	−	−	−	−	−
A. punctulatus moluccensis	+	+	+	+	+	+	+	+	+	− (?)	+	− (?)
A. punctulatus punctulatus	+	+	+	+	+	+	+	+	+	− (?)	+	− (?)
A. subpictus	+	+	+	+	−	+	+	+	−	−	−	−
A. sundaicus	−	−	+	−	−	−	−	−	−	−	−	−
A. tessellatus	+	+	−	+	+	+	+	+	−	−	−	−
A. umbrosus	−	−	−	−	−	−	+	−	−	−	−	−
A. vagus	−	−	−	+	−	+	+	−	−	−	−	−
A. bironella gracilis	+	−	−	−	−	+	+	−	−	−	−	−
A. brionella travestitus	+	−	−	−	−	+	+[2]	−	−	−	−	−

[1] From: Swellengrebel, N. H., and Rodenwaldt, E. Die Anophelinen von Niederlandisch Ostindien, Jena, 1932.
[2] Soetrisno. Filariasis onder de bevolking van de Wae Apo vlakte (Boeroe), Geneesk. Tijdschr. v. Nederl.-Indie 80: 2213–2328, 2375, 1940.
[3] Brug, S. L., and de Rook, H.: Filariasis in Nederl.-Indie, Geneesk. Tijdschr. v. Nederl.-Indie 73: 264–279, 1933.

Table III. Culicines in the Molukken Islands and islands in eastern part of Banda Sea [1]

	Halmahera	Soela	Ternate	Amboina	Saparoea	Ceram	Boeroe	Banda	Aroe	Tanimbar
Aedes aegypti	+	−	+	+	+	+	+	+	−	−
A. abolineatus	−	−	−	−	+	+	−	−	−	−
A. albopictus	−	−	−	+	+	+	−	−	−	−
A. albiscutellatus	−	−	−	−	−	+	−	−	−	−
A. annandalei	−	−	−	−	−	+	+	−	−	−
A. ceramensis aureostriatus [2]	−	−	−	−	−	+	−	−	−	−
A. funereus var. ornata	−	−	−	−	−	+	−	−	−	−
A. imprimens	−	−	−	+	−	+	−	−	−	−
A. lineatopennis	−	−	−	+	−	−	−	−	−	−
A. scutellaris	−	+	−	+	+	+	+	+	+	+
A. tonsus [2]	−	−	−	+	−	−	−	−	−	−
A. vexans	−	−	+	−	−	+	−	−	−	−
A. vigilax	−	−	−	−	−	−	−	−	+	+
Culex alis	−	−	−	−	−	+	−	−	−	−
C. annulirostris	−	−	−	−	−	+	−	−	−	+
C. bitaeniorhynchus										
C. halifaxii	+	−	−	−	−	−	−	−	−	+
C. pullus [2]	−	−	−	−	−	+	−	−	−	−
C. quinquefasciatus	−	−	−	+	+	+	−	+	+	−
C. sitiens	−	−	+	−	−	+	+	−	−	+
C. squamosus [2]	+	−	−	+	−	+	−	−	+	−
C. tritaeniorhynchus var. siamensis	−	−	−	−	−	+	−	−	−	−
C. vishnui	−	−	−	+	−	−	−	−	−	−
Armigeres obturbans	−	−	−	+	−	+	−	−	−	−
A. confusus	−	−	−	−	+	+	−	−	−	−
A. malayi	−	−	−	−	+	+	−	−	−	−
A. spathulatus [3]	−	−	−	−	−	+	−	−	−	−
Mansonia longipalpis	+	−	−	−	−	−	+	−	−	−
M. uniformis	−	−	−	−	−	+	−	−	−	−

[1] From: Bonne-Wepster, J., and Brug, S. L.: Nederlandsch Indische Culicinen, Geneesk. tijdschr. v. Nederl.-Indie 77: 515–617, 1937.
[2] Brug, S. L.: Notes on Dutch East Indian Mosquitoes, Bull. entomol. Research 25: 501–519, 1934.
[3] Brug, S. L.: Notes on Dutch East Indian Mosquitoes, Tijdschr. v. entomologie 82: 91–113, 1939.

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Table IV. Hospitals in the Molukken Islands in 1938 (except New Guinea)

Location	Beds	Administration	Physician in charge	Location physician in charge	Daily direction	Remarks
1. Djailolo (Halmahera).	(?)	District	Public health physician.	Djailolo	Public health physician.	Completed in 1938.
2. Weda (Halmahera)	12	District	Public health physician.	Weda	Public health physician.	Completed in 1937. Badly built, poorly organized.
3. Tobelo (Halmahera)	60	Presbyterian	Public health physician.	Tobelo	Public health physician.	Poorly organized. Sanitary conditions unsatisfactory.
4. Laboeha (Batjan Island).	18	District	Public health physician.	Laboeha	Public health physician.	Unsatisfactory in every respect.
5. Sanana (Soela Island).	6	District	Public health physician.	Sanana	Public health physician.	Unsatisfactory in every respect.
6. Ternate	53	Government	Military physician.	Ternate	Military physician.	Too large for local needs.
7. Amboina	160	Military hospital.	Military physician.	Amboina	Military physician.	Buildings, organization, supplies satisfactory.
8. Saparoea	19	District	Public health physician.	Saparoea	Public health physician.	Built in 1937, well supplied.
9. Amahai (Ceram)	20	District	Public health physician.	Amahai	Public health physician.	Poorly built and organized.
10. Boela (Ceram)	50	Oil Company	Company physician.	Bolea	Company physician.	Built 1937.
11. Geser (Ceram)	20	District	Public health physician.	Geser	Public health physician.	Well organized and satisfactorily equipped.
12. Piroe (Ceram)	20	District	Public health physician.	Piroe	Public health physician.	Spacious and well built, average bed occupancy 15.
13. Riring (Ceram)	10	District	Public health physician.	Riring	Public health physician.	Primitive.
14. Wahai (Ceram)	6	District	Public health physician.	Wahai	Public health physician.	Admissions very scarce.
15. Namlea (Boeroe)	16	District	Public health physician.	Namlea	Public health physician.	Physical plant unsatisfactory. Medical service good.
16. Banda	50	Private	Public health physician.	Banda	Public health physician.	Average bed occupancy 5.
17. Elat (Kai Island)	24	Catholic	Public health physician.	Toeal	Catholic sisters.	Subsidiary of Langgur.
18. Langgur (Kai Island).	28	Catholic	Public health physician.	Toeal	Catholic sisters.	Well equipped.
19. Toeal (Kai Island)	30	Presbyterian	Public health physician.	Toeal	Public health physician.	Formerly a school.
20. Dobo (Aroe Island)	16	District	Public health physician.	Dobo	Public health physician.	Well equipped but small.
21. Saumlakki (Tanimbar).	28	Catholic	Public health physician.	Saumlakki	Public health physician.	Overcrowded.

Note. In Elpapoetih (Ceram), Liang (Amboina), and Mitah (Tanimbar) are emergency wards on the estates without competent medical or nursing care.

Table V. Leprosaria in the Molukken Islands and Southwestern Islands in 1938 (except New Guinea)

	Number of patients
1. Tobelo (Halmahera)	70
2. Ternate	22
3. Amboina	215
4. Banda	14
5. Bay of Elat (Kai)	(?)
6. Dobo (Aroe)	4
7. Saumlakki (Tanimbar)	40

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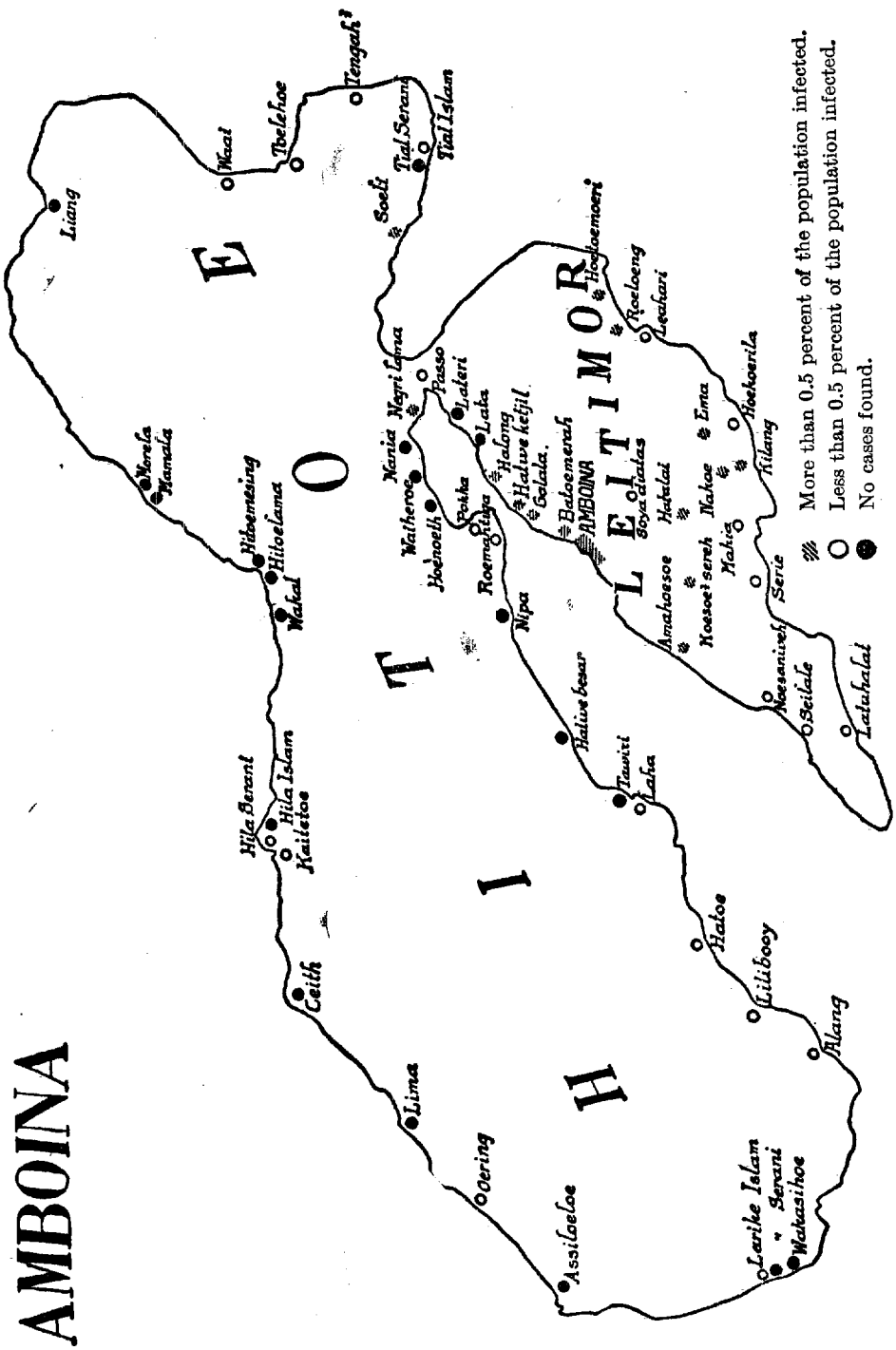

Figure 1. Leprosy in Amboina, 1932.

From: Simons, L. H.: De lepra op het eiland Ambon, Mededeel. v. d. dienst d. volksgezondh in Nederl.-Indie 22: 197–208, 1933.

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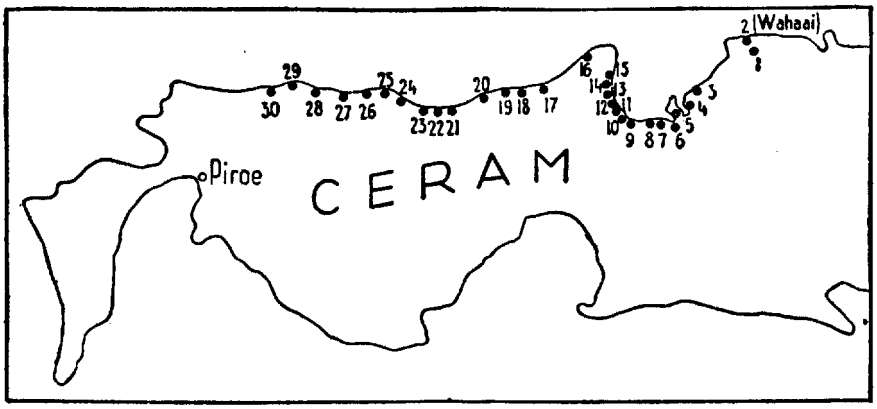

Numbers on table below refer to numbers on map

No.	Villages	No. cases exam.	W.malayi positive		Elephantiasis cases	
			number	%	number	%
1	Solea Marwan	20	2	10	1	5
2	Wahaai	86	3 [1]	3	1	1
3	Opin	29	7	24	6	21
4	Besi	57	4	7	4	7
5	Roemah Olat	57	2	4	0	0
6	Masisihoelan	30	0	0	0	0
7	Sawaai	92	4	4	0	0
8	Roemah Sokat	32	0	0	0	0
9	Seleman	82	8	10	0	0
10	Horale-Pasanea	66	5	8	3	5
11	Horale Roemah Reat	19	1	5	1	5
12	Wailoeloe-Heralaoe	46	12	26	7	15
13	Paoeni	12	2	17	2	17
14	Paä	24	0	0	2	8
15	Karloetoe Kara	35	4	11	4	11
16	Lisela	8	5	62	2	25
17	Lisabata-Roemah Moleh	43	9	21	4	9
18	Roemah Weh	23	3	13	4	17
19	Latea	19	5	26	5	26
20	Karloetoe-Warasiwa	75	4	5	3	4
21	Oewen	52	8	15	3	6
22	Soekaradja	31	7	23	1	3
23	Pitaela	25	6	24	5	20
24	Hatoenoeroe	77	28	36	16	21
25	Ralio Sewalit	28	6	21	3	11
26	Soahoeweh (kust)	65	13	20	3	5
	,, (gebergte)	26	6	23	0	0
27	Pasinalo Noekoehai	90	8	9	0	0
28	Kasieh-Hoelong	74	1	1	0	0
29	Lisahata	25	0	0	0	0
30	Taniwal-Roemah Elen	46	2	4	1	2
	Total	1394	165	12	81	6

1) In addition 2 persons infected with W. bancrofti.

From: Brug, S. L., and de Rook, H.: Filariasis in Nederlandsch-Indie, Geneesk. tijdschr. v. Nederl.-Indie 73: 264-279, 1933.

Figure 2. Filariasis in Ceram.

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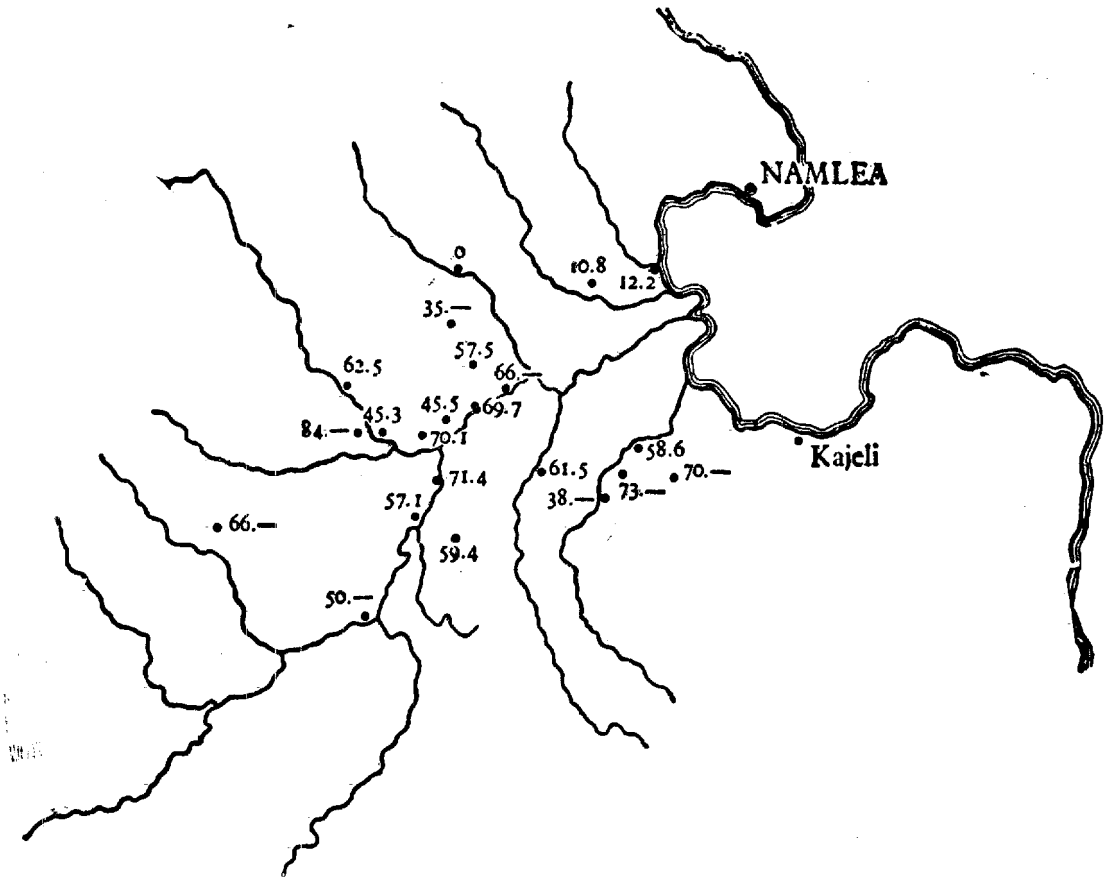

Figure 3. Microfilaria index of the Wae Apo plain on the island of Boeroe.

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